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NATIONAL DAM SAFETY PROGRAM. LAKE WADSWORTH DAM (NJ 00433), DEL--ETC(U)
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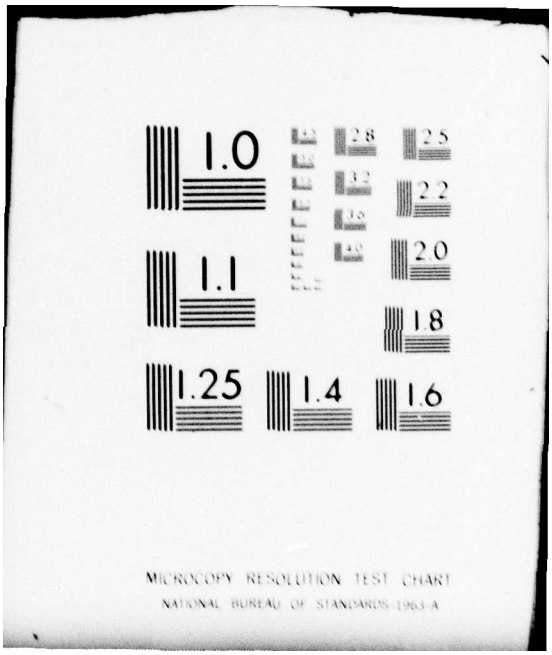
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DELAWARE RIVER BASIN
MANTUA CREEK
GLOUCESTER COUNTY
NEW JERSEY

LEVEL II

LAKE WADSWORTH DAM

NJ 00433

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

August 1979

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National Dam Inspection Act Report
Lake Wadsworth Dam, N.J.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-D

19 NOV 1979

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Wadsworth Lake Dam in Gloucester County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Lake Wadsworth Dam, a high hazard potential structure, is judged to be in fair overall condition. The dam's spillway is considered inadequate since 12 percent of the Spillway Design Flood--SDF - would overtop the dam. (The SDF, in this instance, is one half of the Probable Maximum Flood). The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the determination that dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

Recommended actions are made

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to analyze the dam's embankment and foundation condition relative to seepage and design the regrading of the dam crest near the left abutment and to the right of the spillway. Any remedial measures found necessary should be initiated within calendar year 1980.

c. The following remedial actions should be completed within one year from the date of approval of this report:

(1) Inspect the condition of the downstream slopes behind the spillway wingwalls and provide addition slope protection as required.

(2) Repair the spalled concrete surfaces at the ends of the horseshoe spillway crest, the tops of the crestwalls at the sides of the spillway and the vertical cracks in the downstream wingwalls.

(3) Examine and repair the riser stem and wheel of the sluice gate.

(4) Backfill and compact eroded and sloughed areas along the upstream embankment.

(5) The downstream culvert under Delsea Drive should be excavated by the New Jersey Department of Transportation to restore its designed hydraulic capacity.

(6) The owner should contact the Division of Water Resources for information relative to annual safety inspections and develop a checklist of maintenance procedures so that records of inspections and conditions can be maintained.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James J. Florio of the First District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

NAPEN-D
..Honorable Brendan T. Byrne

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

James G. Ton

1 Incl
As stated

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

LAKE WADSWORTH DAM (NJ00433)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 9 May 1979 by Louis Berger and Associates, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Lake Wadsworth Dam, a high hazard potential structure, is judged to be in fair overall condition. The dam's spillway is considered inadequate since 12 percent of the Spillway Design Flood--SDF - would overtop the dam. (The SDF, in this instance, is one half of the Probable Maximum Flood). The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the determination that dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to analyze the dam's embankment and foundation condition relative to seepage and design the regrading of the dam crest near the left abutment and to the right of the spillway. Any remedial measures found necessary should be initiated within calendar year 1980.

c. The following remedial actions should be completed within one year from the date of approval of this report:

(1) Inspect the condition of the downstream slopes behind the spillway wingwalls and provide additional slope protection as required.

(2) Repair the spalled concrete surfaces at the ends of the horseshoe spillway crest, the tops of the crestwalls at the sides of the spillway and the vertical cracks in the downstream wingwalls.

(3) Examine and repair the riser stem and wheel of the sluice gate.

(4) Backfill and compact eroded and sloughed areas along the upstream embankment.

(5) The downstream culvert under Delsea Drive should be excavated by the New Jersey Department of Transportation to restore its designed hydraulic capacity.

(6) The owner should contact the Division of Water Resources for information relative to annual safety inspections and develop a checklist of maintenance procedures so that records of inspections and conditions can be maintained.

APPROVED: James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 14 Nov 1979

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam: Lake Wadsworth Dam Fed ID# NJ 00433
and NJ ID# 71

State Located New Jersey
County Located Gloucester
Coordinates Lat. 3944.2 - Long. 7506.8
Stream Mantua Creek
Date of Inspection 9 May 1979

ASSESSMENT OF GENERAL CONDITIONS

Lake Wadsworth dam is assessed as being in a fair overall condition although the spillway is inadequate. The dam appears to be susceptible to overtopping and further engineering studies are recommended in the future to study the seepage and regrading of the dam crest near the left abutment and to the right of the spillway wingwall. Remedial actions to be undertaken in the future include: 1) provide additional slope protection behind the spillway wingwalls, 2) repair all spalled and cracked concrete in the spillway, 3) rehabilitate the sluicegate and 4) backfill the eroded areas on the upstream face of the embankment.

The capacity of the spillway will accommodate only 11% of the design flood (½ PMF) but the dam is not assessed

as UNSAFE, NON-EMERGENCY as failure from overtopping would not significantly increase the downstream hazard to loss of life that would exist just before overtopping failure occurred. Hence, the spillway is not rated as seriously inadequate.

F. Keith Jolls P.E.
Project Manager

OVERVIEW OF LAKE WADSWORTH DAM

MAY, 1979

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NAME OF DAM: LAKE WADSWORTH DAM FED ID# NJ 00433

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The State, in turn, is under agreement with the U.S. Army Engineer District, Philadelphia, to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Lake Wadsworth Dam and appurtenant structures, and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Lake Wadsworth Dam is an irregular 350 foot long earth embankment with a centrally located, reinforced concrete semicircular arch spillway. The right embankment section is approximately 110 feet long, terminating on the north at Pitman Downer Road. The spillway consists of a circular arch with an overall arc length of 53.3 feet with a 3" notch in the center 18 feet. The spillway crest is 12.5 feet above the stilling basin, which is edged by a two foot high concrete lip 31 feet downstream. The top of the spillway wingwalls and dam crest are 4 feet higher than the spillway. The heavily

wooded left embankment is approximately 200 feet long with a top width of 12 feet and has 1H:1V slopes. A portion of its downstream slope is backed by an old masonry brick wall and counterforts for approximately 60 feet.

b. Location

Lake Wadsworth dam is located 250 feet east of Route 47 (Delsea Drive) in the Borough of Glassboro and Washington Township, New Jersey (the corporate boundary bisects the spillway). The dam is built across Mantua Creek approximately 1,000 feet downstream from its confluence with Duffield Run at the Sterling Lake Dam (NJ 00434). Lake Wadsworth is also known as Cresse (or Kressey) Lake.

c. Size Classification

The maximum height of the dam is 19.5 feet with a maximum storage capacity of 152 acre-feet. Accordingly, the dam is in the small size category as defined by the criteria in the Recommended Guidelines for Safety Inspection of Dams (storage less than 1,000 acre-feet and height less than 40 feet).

d. Hazard Classification

Based upon Corps of Engineers criteria, the dam is classified as high hazard as the Pitman power substation of the Atlantic City Electric Company is located immediately below the left embankment and a failure could severely disrupt electrical service to the surrounding community. Further, 250 feet downstream is a hydraulically substandard 24 foot wide culvert under Route 47 which would be flooded if a dam collapse occured (with possible disruption of numerous utilities as well as traffic on Route 47).

e. Ownership

This dam is owned by Mr. Wayne Goff, c/o Goff Nursery, Delsea Drive, Pitman, New Jersey.

f. Purpose of Dam

The dam is used solely for recreational purposes, impounding a privately owned lake.

g. Design and Construction History

Particulars of the original design and construction of the Lake Wadsworth dam are uncertain and undocumented. The original structure (with timber spillway) was overtopped and breached during a heavy rainstorm on July 15, 1925. The breach caused considerable damage to the downstream roadway and to the Atlantic City Electric Company's transformer station. Repairs to the dam, performed by Michael Straub and Kolyn Construction Company, were completed in March 1926 and included the construction of a concrete semi-circular arch spillway designed by Mr. Dirk A. Dedel as well as the addition of a steel sheet piling cut off wall in portions of the embankment on either side of the spillway. In October 1932 and May 1940, inspections showed that the embankment had undergone erosion which warranted repair. The owner, Mr. Wadsworth Cresse, was notified each time and repairs were made shortly thereafter. On September 1, 1940, the dam was again overtopped as a result of severe flooding which had caused two upstream dams to fail. The concrete spillway was undamaged, but approximately 50 feet of the right embankment and 40 feet of the left embankment near Delsea Drive were washed out. However, the transformer station and U.S.G.S. gauge house on the left embankment were not damaged. The subsequent repairs to the dam were performed by Edward H. Ellis Inc., General Contractors of Westfield, N.J. Although the State Water Policy Commission recommended that 2½ inch T.&G. sheeting with 4" x 5" walers be driven into the embankment, it is not known whether or not this was actually done. In December 1970, further repairs to the dam, performed by Eastern Divers, Inc. included 1) patching of the concrete spillway with epoxy-resin concrete, 2) the stem and wheel of the sluicegate were replaced and 3) an expansion crack in the west wall was strapped and supported by a concrete cap.

h. Normal Operating Procedures

Operations are conducted by the owner who lives on an island on the easterly end of the lake and maintains a commercial nursery business just to the south on Delsea Drive (see Section 4).

1.3 PERTINENT DATA

a. Drainage Area

The drainage area of Lake Wadsworth is 6.7 square miles.

b. Discharge of Dam Site

The spillway capacity with the reservoir at crest elevation is calculated to be approximately 1,280 cfs. Discharge records are available at this site as a stage discharge gaging station is located on the dam. Maximum recorded discharge is 4,200± cfs (1940).

c. Elevation (Above M.S.L.)

Recreation Pool - 71.0
Top of Dam - 75.0
Streambed at Center Line of Dam - 55.5±

d. Reservoir

Length of Recreation Pool - 1,800 feet
Length of Maximum Pool - 2,200 feet

e. Storage

Recreation Pool - 70 acre-ft.
Top of Dam - 152 acre-ft.

f. Reservoir Surface

Recreation Pool - 13.3 acres
Top of Dam - 27.7 acres

g. Dam

Type - Earth embankment with concrete spillway
Length - 350 feet

Structural Height - 19.5 feet (at spillway)
Freeboard between normal reservoir and top of dam - 4.0 feet
Top Width - 15+ feet
Side Slopes - 1:1 (upstream), 1.5H:1V (downstream)
Zoning - composition and compactness unknown

h. Diversion and Regulating Tunnel

None

i. Spillway

Type - Concrete, semi-circular arch weir
Length of Weir - 53.3 feet (effective length = 50')
Crest Elevation - +71.0

j. Regulating Outlet

24" vertical lift steel sluice gate (invert elevation +60.5±)

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Design plans were available only for the 1925 concrete spillway construction which were prepared by Mr. Dirk A. Dedel. The design indicated the overall height, geometry and footing dimensions and called for a 1:2:4 concrete mix (2,500± psi) and steel sheeting to be driven along the dam axis but the extent of this corewall is unknown. It appears from photographs that the corewall was entirely washed out in the 1940 flood. The circular spillway and downstream apron are supported by a steel sheeting cofferdam. No design analyses or records of any subsurface investigations were located although a compact grey sand was uncovered during the 1925 construction. The predominant soils in the vicinity are composed of recent alluvium sands and silts with discontinuous intermingled layers of clay. The alluvium overlies swampy deposits in some areas which are generally encountered at depths less than ten feet. Below this is Kirkwood sand, in most areas extending down to bedrock. Drainage of the foundation soils is usually poor and the depth to bedrock is greater than 100 feet.

2.2 CONSTRUCTION

No data was located regarding who accomplished the initial construction or what records were kept. As the dam has always been in private ownership, it is doubtful if any additional records are readily available other than those at the Division of Water Resources.

2.3 OPERATION

The dam has operated as an uncontrolled overflow facility with very infrequent regulation of the lake level by use of the 24-inch sluice gate (see Section 4).

2.4 EVALUATION

a. Availability

Sufficient engineering data is available to determine the structural adequacy of the concrete spillway although no meaningful design computations were located. No data was acquired upon which to base an assessment with regards to the embankment composition or zoning. However, except for the zone immediately to the right of the spillway, this is not particularly relevant (see Section 6) and the power station benched area stabilizes the entire left embankment.

b. Adequacy

The engineering data relating to the spillway is regarded as sufficiently adequate to render the following assessment without recourse to gathering further information. However, it is believed that further data relating to the earth embankment would be required in the future and such additional information should include embankment cross sections, borings and piezometer readings in selected localities (see Section 7).

c. Validity

The validity of the spillway data is not challenged as the inspection revealed it exists substantially as designed.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

Visual inspection was conducted on 9 May 1979 and revealed the spillway to be carrying a constant flow. The inspection team also reviewed the conditions at the Sterling Lake dam (which is at the Wadsworth Lake headwaters) in light of its juxtiposition and past records of failure. This dam is reported on separately.

b. Dam

The dam crest is fairly level except at the left abutment and heavily wooded, as are the sideslopes. Both the upstream and downstream slopes are very irregular and have few areas where the original grades are stabilized. The downstream slope to the left of the spillway has been regraded by the Atlantic City Electric Co. substation site work, leaving a effective embankment height of 6 to 8 feet. There is considerable sloughing of the slopes behind the downstream wingwalls, in spite of some recently placed concrete block slope protection. Also, there are numerous smaller eroded areas along the upstream slopes. Immediately to the left of the spillway, there is a 60' long brick masonry wall built along the downstream edge of the crest. This counterforted wall retains the crest embankment from obtruding onto the power station property. The U.S.G.S. gaging station is situated immediately above the wall on the dam crest. The wall appears to be part of a foundation of an earlier building which occupied part of the substation property.

The crest to the right of the spillway is more heavily eroded and considerably distorted by numerous foot paths and trails. There is evidence of clear seepage emanating at the toe of the downstream wingwall over a width of about 20 feet. The phreatic line is about 3 to 4 feet above the lower streambed.

Additionally, there is a low (2'-3') stone masonry wall just below the crest near the left abutment. This wall is badly deteriorated and was apparently installed after the 1940 flood when a small breach occured in this area. Just downstream of this wall is a small brick building which houses a municipal sewage pumping station.

c. Appurtenant Structures

The semi-circular concrete spillway is 34 feet wide and has an 18' by 3" notch formed in the center portion. The crest shows no differential settlement and is in moderately good structural condition except both downstream wingwalls have major structural cracks (which have been repaired in some areas with wrought iron straps and expansion bolts. According to records, these cracks occurred immediately after the construction was completed in 1925. The exposed tops of the wingwalls are badly eroded with several inches of concrete spalled off. The walls are 4 feet above spillway crest and establish the dam crest elevation.

The condition of the 16" thick concrete invert slab could not be observed due to the depth of water which is confined by the 2' high sill at the downstream edge. However, as this is cast monolithically (and heavily reinforced) with the wingwalls and horseshoe arch, minor cracking would cause no undue concern.

The 24" low level gate is positioned on the right of the spillway. The stem is bent out of alignment but appears to be operable if the stem is straightened up. The stand and wheel are presently partially buried and the timber operating platform indicated on the design drawings is completely demolished.

d. Reservoir Area

The reservoir has a stable, well-defined shoreline and is fairly clear of debris. The slopes are fairly steep except near each abutment and heavily wooded. The present owner lives on a small

island near the Sterling Lake dam which discharges the Duffield Run tributary into Mantua Creek about 1,000 feet southeast of the study dam. The shoreline along the south westerly edge is considerably steeper and for the most part, undeveloped. The lake bed is composed of sand and gravel and there appears to be very little siltation.

e. Downstream Channel

Mantua Creek flows under Delsea Drive 250 feet downstream from the dam. The left bank is protected by an 8 foot high timber bulkhead constructed from the left wingwall of the spillway to this 24 foot wide culvert. This protection places the substation platform about 2 feet above the street grade on Delsea Drive. The downstream channel is quite heavily silted up and the hydraulic capacity of the box culvert is severely restricted. Delsea Drive, according to records, was overtopped by 5.5 feet of water during the 1940 storm. Roughly 600 feet further downstream, Mantua Creek passes under Holly Drive in three 72" CMP culverts.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Operational procedures were not observed by the inspection team. The spillway operates as an uncontrolled weir and there are no current records of any procedures in effect.

4.2 MAINTENANCE OF DAM

Recently, modest attempts have been undertaken by the owner to stabilize the eroded areas at each side of the downstream wingwalls. About 10 years ago, certain areas of the spillway concrete were repaired with epoxy-resin and the previously mentioned vertical cracks in the wingwalls were strapped with steel ties. It appears there has been no maintenance of the embankment since it was repaired in 1940.

4.3 Maintenance of Operating Facilities

There is no day-by-day operation as the only facility is the low-level 24" sluicegate.

4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

No formal system exists except for monitoring by local police and Civil Defense personnel during heavy storms. As previously stated, the owner resides on an island in the lake and is cognizant of the past history of overtopping and his responsibilities.

4.5 EVALUATION OF OPERATIONAL ADEQUACY

The present operational procedures are deemed to be adequate in view of the owner's proximity to the site and the lack of downstream hazards insofar as human life is concerned. As evidenced by the two previous failures, the safety of the Lake Wadsworth dam is only exacerbated should failure of any of the several upstream dams occur. This, in no way, eschews the necessary remedial measures that are recommended in Section 7.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data

Based on the criteria in the Recommended Guidelines for Safety Inspection Dams, Lake Wadsworth dam is small in size but is classified as high hazard. One half the probable maximum flood was selected as the design storm by the inspecting engineer. Precipitation data was obtained from Hydrometeorological Report #33. The routed outflow from Sterling Lake was included in the overland inflow to Lake Wadsworth. The inflow hydrograph and reservoir routing were computed utilizing the HEC-1 computer program. This gave a peak inflow to the reservoir of 11,823 cfs (5,483 cfs from Sterling plus 6,442 cfs from the remaining drainage area; the slight difference is caused by staggering of the peaks). Routing this through the reservoir reduced this total inflow slightly to an outflow of 11,754 cfs. The spillway capacity before overtopping occurs is 1,280 cfs and thus can accommodate only 11% of the design flood and is therefore considered inadequate.

b. Experience Data

No meaningful original design data was available for review. Records do indicate however, that three separate sections of dam were washed out in September 1940 during a severe storm. A maximum discharge of 4,200 cfs was later computed as this flood overtopped the spillway by 5.6 feet. By comparison, the PMF design flood would overtop the spillway by 8.4 feet.

c. Visual Observations

The spillway structure appears to be in a satisfactory condition except for the questionable condition of the low-level sluice. From a hydraulic standpoint, the major concern of the inspection team was the lower portions of the dam crest near the left abutment.

d. Overtopping Potential

Based on the results of the hydraulic analysis, the capacity of the spillway is inadequate to accommodate the SDF (see Paragraph 7.1.a). The dam has been overtopped at least twice in the past and the hydraulic review indicates there remains considerable potential for overtopping in the future.

e. Drawdown

At the present time it could prove difficult to dewater the lake via the 24" blowoff pipe as the gate may be inoperable. However, should this situation be remedied, it would take approximately a day and a half to dewater this lake, assuming no inflow from Sterling Lake.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

As a result of the field inspection and review of the spillway design plans, the structural stability of the dam is believed to be moderately good although the crest is susceptible to overtopping, especially should any of the upstream dams fail. The two areas on the embankment crest which were of concern are at the left abutment and immediately to the right of the spillway. At the former, overtopping would flood into Delsea Drive, the sewage pump house and into the electrical sub-station property. In this area, the crest appeared to be between 1 and 2 feet below the design crest although the exact amount could not be determined due to the heavy undergrowth on the crest. The latter area, behind the downstream wingwall, has been recently partially protected with cinder-block slope protection but remains a critical zone with seepage emenating several feet above the downstream flowline. The rate of flow was extremely small and could not be meaningfully estimated.

b. Design and Construction Data

Summarizing Section 2, no detailed design computations or construction plans were available to fully assess all of the elements of the spillway but sufficient overall dimensions were obtained which, together with the field observations, reveal a conservative, well-engineered design. Based on its observed condition, the position and size of reservoir, it is believed that additional structural studies are unnecessary. However, as set forth in Section 7, additional hydraulic review could possibly result in upgrading the long-term operating characteristics.

c. Operating Records

The performance of the spillway appears to have been satisfactory since the 1940 breaching. There are no records regarding other operational deficiencies except further deterioration of the structure since the most recent (1974) inspection.

d. Post Construction Changes

There have been no major modifications since the 1925 construction of the main elements of the dam as they exist today. However, the electrical substation has been modified in more recent times, and the left bank of the downstream channel protected by the timber bulkhead. The finished grade of the substation area has been raised which additionally helps stabilize a considerable portion of the dam embankment.

e. Seismic Stability

The dam is located in Seismic Risk Zone 1 and experience indicated that dams in this zone will have adequate stability under dynamic loading conditions if they are stable under static loading conditions. In the opinion of the inspection team this dam is stable under static loading conditions.

SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/ REMEDIAL SECTIONS

7.1 DAM ASSESSMENT

a. Safety

Subject to the inherent limitations of the Phase I visual inspection, Lake Wadsworth Dam is judged to be in a fair but sound overall structural condition although the spillway is capable of discharging only 11% of the ½ PMF design flood. However, the dam is adjudged not to be UNSAFE, NON-EMERGENCY, in the opinion of the inspection team a failure from overtopping would not significantly increase the hazard to loss of life downstream from the condition that would exist just before overtopping failure. Due to the downstream hydraulic constraints at Route 47 and Holly Drive, a high tailwater condition would be present just below the study dam and the overtopping would not appreciably worsen this condition.

There is no economically feasible way of increasing the present spillway capacity and the potential for overtopping the southwesterly end of the embankment (near the left abutment) remains considerable. No detrimental findings, except for seepage flow, were observed which cannot be alleviated by the remedial repairs enumerated below.

b. Adequacy of Information

The information obtained for the Phase I inspection is deemed to be adequate for the enclosed assessment but additional geotechnical information would be required should further studies be undertaken regarding the seepage.

c. Urgency

No immediate urgency is attached to implementing any further studies and the remedial measures set forth below should be undertaken in the future.

d. Necessity for Further Study

In view of the downstream conditions reflecting the high hazard classification, further studies are recommended relating to the seepage and hydraulic operations.

7.2 RECOMMENDATIONS/REMEDIAL ACTIONS

It is recommended that further engineering studies be initiated in the future to study 1) the seepage zone behind the right spillway wingwall and 2) the re-grading of the dam crest near the left abutment and to the right of the spillway. At that time, consideration could be given to installing an auxiliary spillway immediately behind the right wingwall to augment the discharge capacity.

a. Recommendations

- Inspect the condition of the downstream slopes behind the spillway wingwalls and provide additional slope protection as required.

- Repair the spalled concrete surfaces at the ends of the horseshoe spillway crest, the tops of the crestwalls at the sides of the spillway and the vertical cracks in the downstream wingwalls.

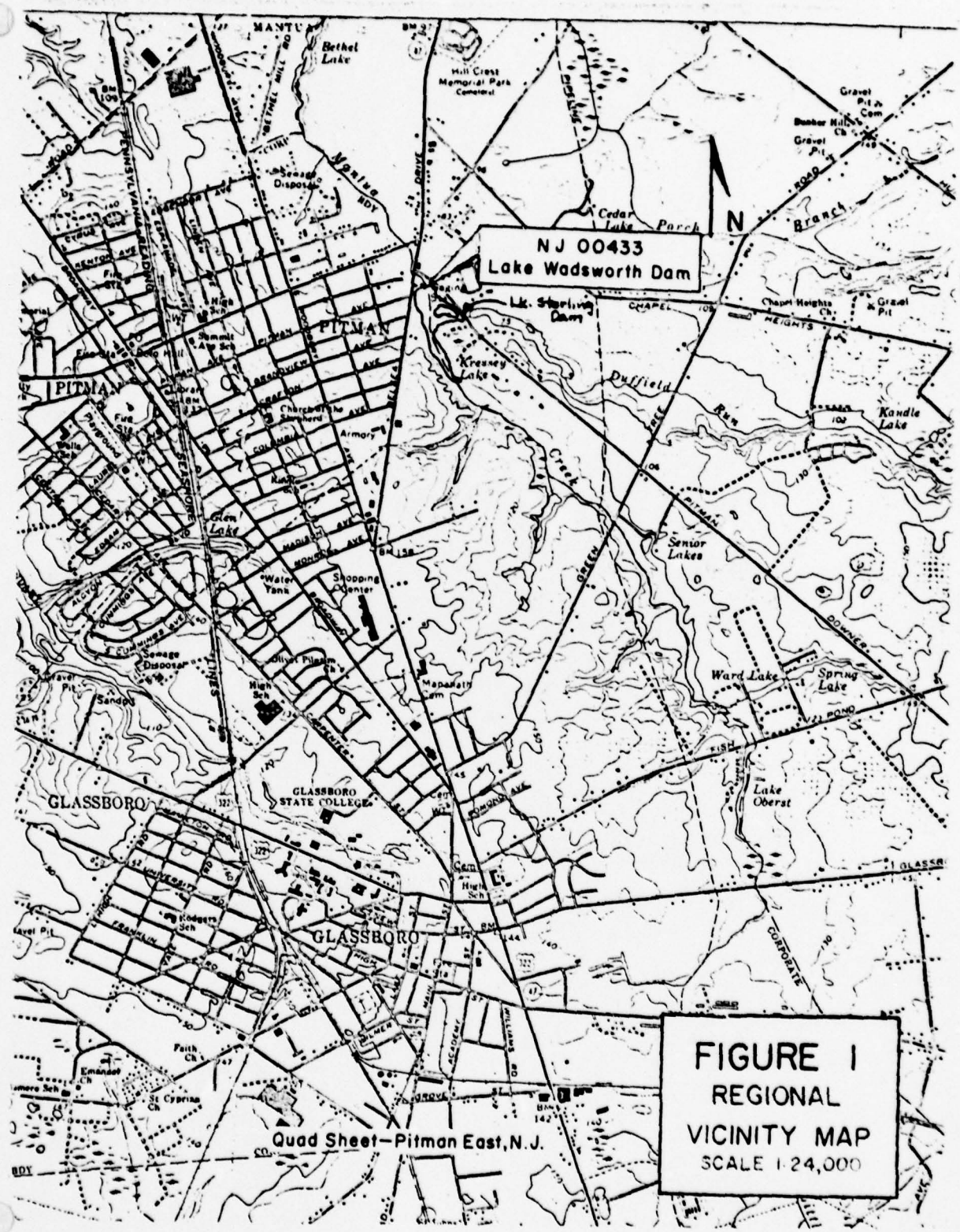
- Examine and repair the sluicegate riser stem and wheel.

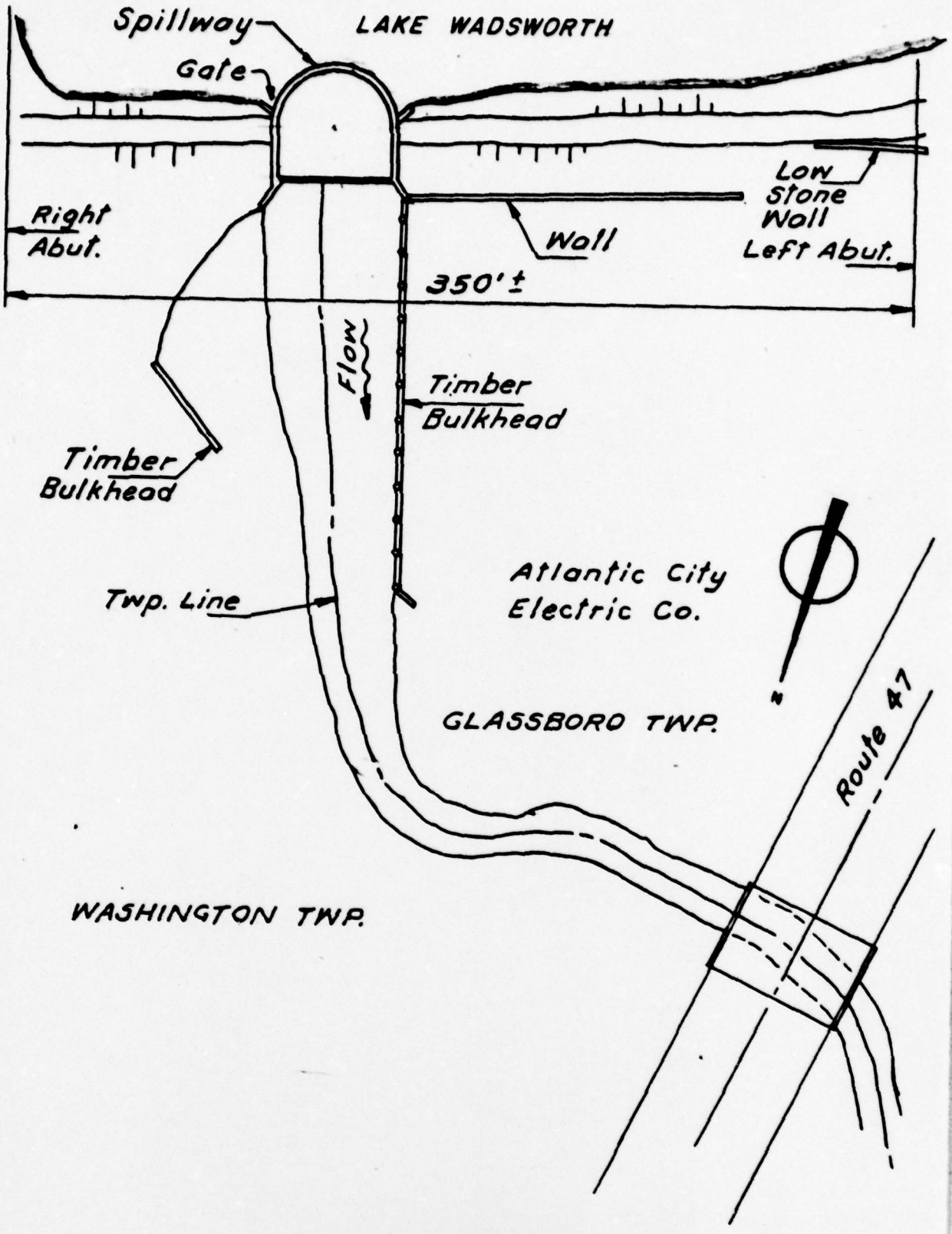
- Backfill and compact eroded and sloughed areas along the upstream embankment.

Further, the downstream culvert under Delsea Drive should be excavated by the NJDOT to restore its full hydraulic capacity.

b. O&M Maintenance and Procedures

No additional procedures other than those currently in effect appear to be warranted. The owner should contact the Division of Water Resources for information relative to annual safety inspections and develop a checklist of maintenance procedures so that records of inspections and conditions can be maintained.

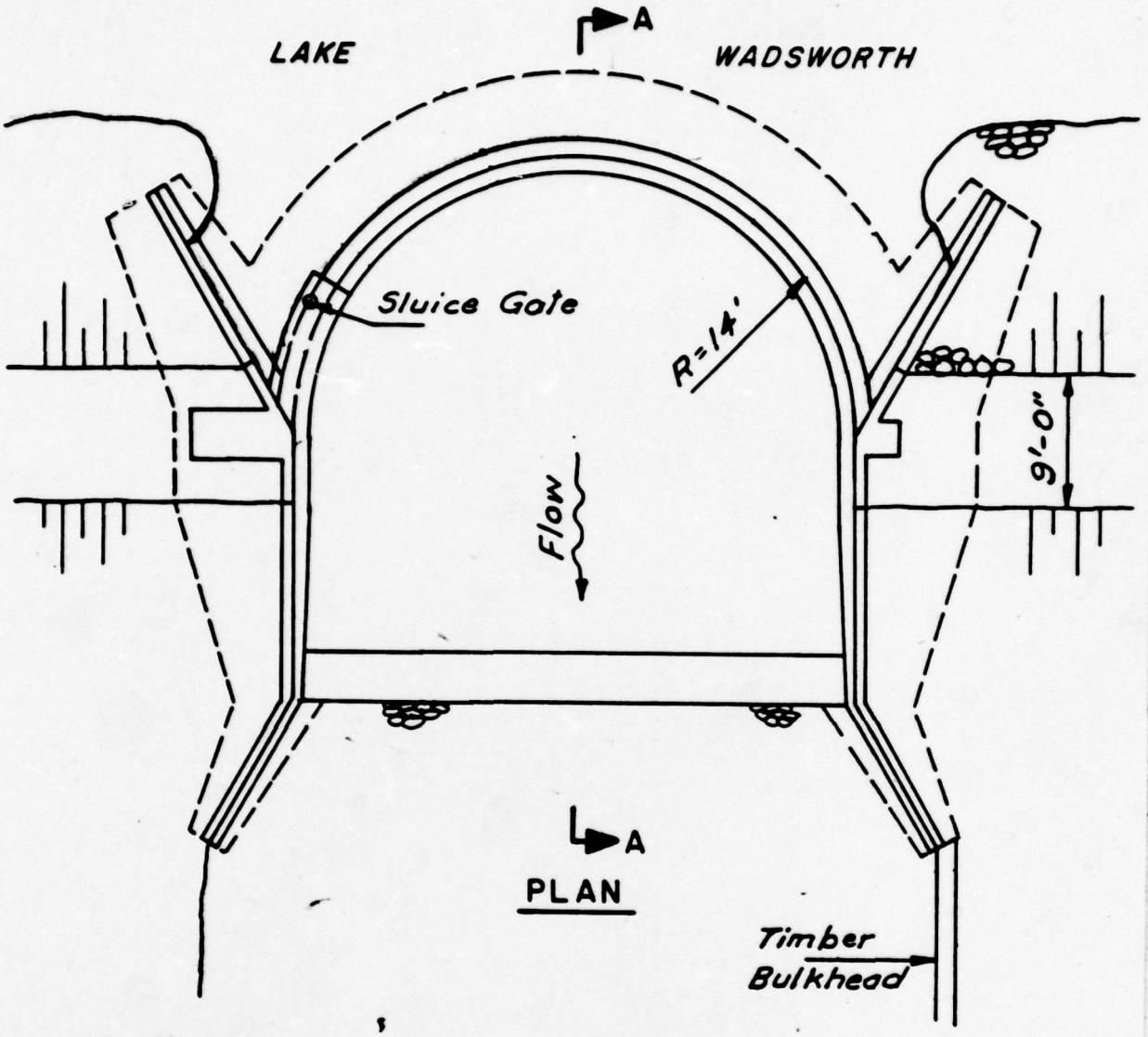

NJ 00433
Lake Wadsworth Dam
N
MANTUA
Bethel Lake
Hill Crest Memorial Park Cemetery
Gravel Pit & Com
Gravel Pit
Cedar Lake Park
Lk. Sterling Dam
Chapel Heights Ch.
Gravel Pit
Kresney Lake
Duffield Run
Kandle Lake
PITMAN
Glen Lake
Water Tank
Shopping Center
Senior Lakes
Ward Lake
Spring Lake
Lake Oberst
Sewage Disposal
Sandpit
High Sch
Oliver Pilgrim Ch
Mapleton Cem
GLASSBORO
GLASSBORO STATE COLLEGE
Rodgers Sch
Faith Ch
Emanuel Ch
St Cyprian Ch
Quad Sheet—Pitman East, N.J.
FIGURE 1
REGIONAL
VICINITY MAP
SCALE 1:24,000

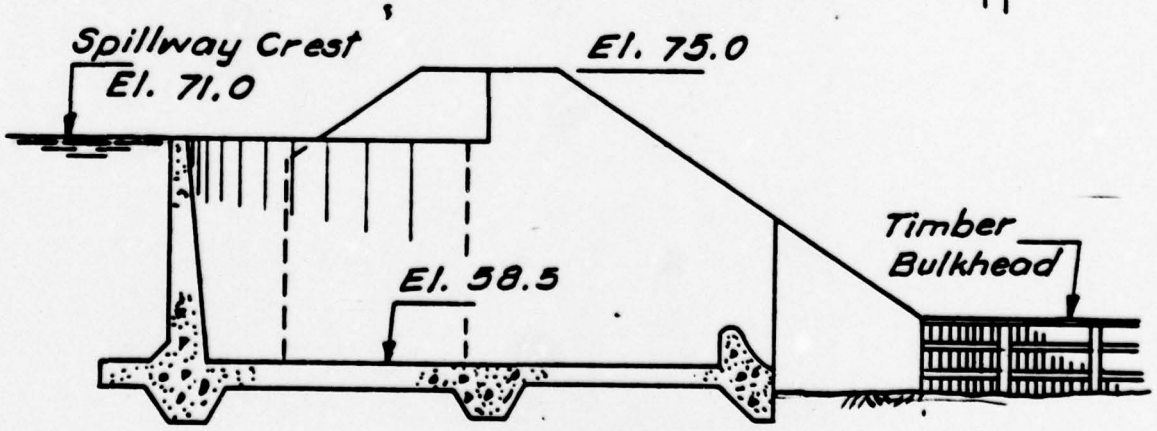


LOCATION PLAN

Not to Scale

FIGURE 2





SECTION A-A

FIGURE 3

Check List
Visual Inspection
Phase 1

Name Dam Lake Wadsworth County Gloucester State New Jersey Coordinators NJDEP

Date(s) Inspection 9 May 1979 Weather Clear Temperature 80°

Pool Elevation at Time of Inspection 71.3 M.S.L. Tailwater at Time of Inspection 56+ M.S.L.

Inspection Personnel:

K. Jolls

L. Baines

K. Greenfield

K. Jolls Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed. Very old embankment. Heavily wooded crest and slopes.	Trees cannot be removed without destroying embankment.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed. Highly irregular slopes on dam face.	Downstream slopes minor consideration. Only 6'-8' drop to grade below dam.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Bicycle trails have eroded crest in several areas. Several sloughed areas on foreslopes.	Crest should be regraded.
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Very irregular but satisfactory. Some erosion of embankment to each side of spillway wingwalls.	1) Left wingwall downstream slope should be repaired (deep footpath). 2) Both slopes should be protected where deeply cut.
RIPRAP FAILURES	Old concrete block placed as slope protection adjacent to spillway.	Condition satisfactory.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
	Old masonry brick wall and counterforts below gaging station. Height approximately 8'.	Keeps backslope off level power station wall and fence(acts as a retaining wall).
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Low area at right abutment (at edge of Pitman-Downer Rd.)	Could act as auxiliary spillway. (crest - 2 feet below dam crest.) Elevation approx. equal to low area at left abutment.
ANY NOTICEABLE SEEPAGE	None observed	
STAFF GAGE AND RECORDER	None	
DRAINS	None	

OUTLET WORKS CONCRETE SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Some cracking in lower portion of wingwalls (recently repaired).	
INTAKE STRUCTURE	Circular weir - good condition.	
OUTLET STRUCTURE	Paved slab below weir. (water too deep to observe.)	Concrete sill at outlet edge.
OUTLET CHANNEL	Bounded by timber bulkhead along transformer station property.	
EMERGENCY GATE	None	

UNGATED SPILLWAY (N/A - See previous page)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	See previous page	
APPROACH CHANNEL	Main lake reservoir	
DISCHARGE CHANNEL	Clear. 40' wide tapering to 20' at Rt. 47 bridge. Appears heavily silted up.	Channel ownership could not be determined. Culvert at 47 should be excavated.
BRIDGE AND PIERS	None	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	Stream flow measuring gate to left of spillway. U.S.G.S. Station	See 1976 Water Resources Data of U.S. G. S.

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Fairly steep; well confined and stable lake area.	Heavily wooded slopes. Lake clear of debris - well maintained.
SEDIMENTATION	None observed along shores (sand and gravel bottom)	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Clear of debris	
SLOPES	Entire left channel - 8' (exposed height) timber bulkhead along transformer station. (Extends all the way to Rt. 47 bridge.)	
APPROXIMATE NO. OF HOMES AND POPULATION	Power station: Atlantic County Electric Company. Pumping station just below left abutment area.	
	Bridge at Delsea Drive. Single span culvert (clear opening 20 x 4).	Built in 1929. Channel heavily silted up. Inadequate hydraulically and should be cleaned out.

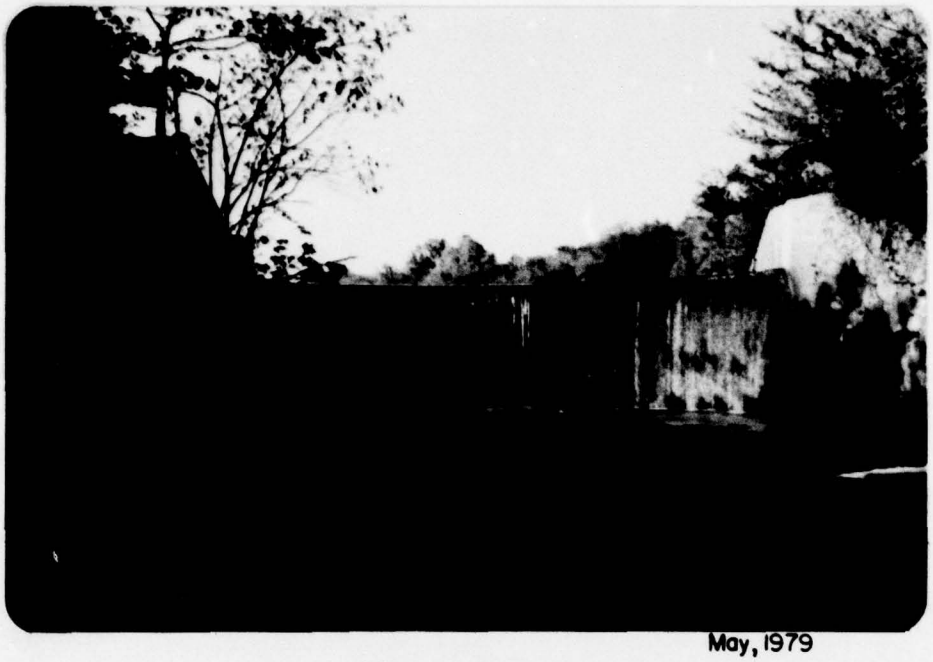
CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Unavailable
REGIONAL VICINITY MAP	Available (USGS Quad)
CONSTRUCTION HISTORY	Available (NJDEP)
TYPICAL SECTIONS OF DAM	Available (NJDEP)
HYDROLOGIC/HYDRAULIC DATA	Available (NJEDP)
OUTLETS - PLAN	Available (NJDEP)
- DETAILS	Available (NJDEP)
-CONSTRAINTS	Not Available
-DISCHARGE RATINGS	Not Available
RAINFALL/RESERVOIR RECORDS	Available Water Resources Data of U.S.G.S.

ITEM	REMARKS
SPILLWAY PLAN	Available (NJDEP)
SECTIONS	Available (NJDEP)
DETAILS	Available (NJDEP)
OPERATING EQUIPMENT PLANS & DETAILS	Not available

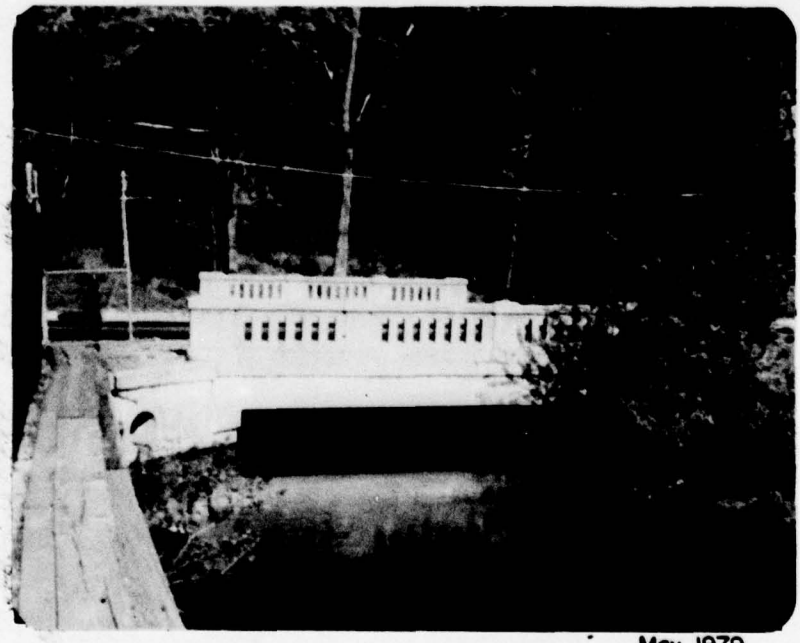
ITEM	REMARKS
DESIGN REPORTS	Not available
GEOLOGY REPORTS	Not available
DESIGN COMPUTATIONS	Not available
HYDROLOGY & HYDRAULICS	Not available
DAM STABILITY	Limited available (NJDEP)
SEEPAGE STUDIES	Not available
MATERIALS INVESTIGATIONS	Not available
BORING RECORDS	Not ayailable
LABORATORY	Not available
FIELD	Not available
POST-CONSTRUCTION SURVEYS OF DAM	Unknown
BORROW SOURCES	Unknown

ITEM	REMARKS
MONITORING SYSTEMS	U.S.G.S. Gaging Station
MODIFICATIONS	None
HIGH POOL RECORDS	Water Resources
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Not available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	1925, 1940 Available Not available
MAINTENANCE OPERATION RECORDS	Several inspection reports available. (NJDEP)



May, 1979

View of Spillway



May, 1979

View of Highway Culvert Approx. 150' Downstream from Dam

May, 1979

View of Buttressed Wall - Downstream Slope of Left Embankment

May, 1979

View of Erosion of Downstream Slope of Right Embankment

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 6.7 sq. mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 71 M.S.L. (70 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 75 M.S.L. (152 acre-feet)

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 75 M.S.L.

CREST:

a. Elevation +75.0
b. Type earth embankment
c. Width 15'
d. Length 350
e. Location Spillover None
f. Number and Type of Gates None

OUTLET WORKS:

a. Type Semi-circular weir (50' effective length)
b. Location 120' from right abutment
c. Entrance inverts +71
d. Exit inverts +55.5
e. Emergency draindown facilities 1 - 24" sluice gate

HYDROMETEOROLOGICAL GAGES: Hydro unit #02040202
a. Type Water Quality
b. Location on dam crest
c. Records 1940-1976

MAXIMUM NON-DAMAGING DISCHARGE: 1280 cfs

BY. D.J.M. DATE 6-79.
CHKD. BY _____ DATE _____
SUBJECT _____

LOUIS BERGER & ASSOCIATES INC.

WADSWORTH LAKE DAM

SHEET NO. A1 OF _____
PROJECT C234

Time of concentration :

length along longest water course to drainage divide = 3.1 miles

= 16,368'

$\Delta H = 70'$ Slope ≈ 0.43%

assume velocity of 2 ft. s^{-1}

$$\therefore t_c \approx \frac{16,368}{2 \times 3600} = 2.27 \text{ hours}$$

By California Culverts Method :

$$t_c \approx \left(\frac{11.9 \times 3.1^3}{70}\right)^{0.385} = 1.9 \text{ hours}$$

By Kirpichs' formula :

$$t_c = 0.00013 \times \frac{16368^{0.77}}{0.0043^{0.385}} = 1.86 \text{ hours}$$

Use t_c = 2 hrs

$$t_p = \frac{0.25}{2} + 0.6 \times 2 = 1.33 \text{ hours}$$

$$Q_p = \frac{484 \times 3.6}{1.33} = 1315 \text{ cfs}$$

BY. D.J.M. DATE 6-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A2 OF.
CHKD. BY. DATE. WADSWORTH LAKE DAM PROJECT C.234
SUBJECT

UNITGRAPH :

Time	T/T_p	Dimensionless Ordinate DO	Q (cfs) $= Q_p \times DO$
0.25	0.19	0.067	88
0.50	0.38	0.250	329
0.75	0.56	0.530	697
1.00	0.75	0.830	1091
1.25	0.94	0.990	1302
1.50	1.13	0.964	1268
1.75	1.32	0.820	1078
2.00	1.50	0.660	868
2.25	1.69	0.488	642
2.50	1.88	0.378	497
2.75	2.07	0.289	380
3.00	2.26	0.221	291
3.25	2.44	0.168	221
3.50	2.63	0.124	163
3.75	2.82	0.095	125
4.00	3.01	0.074	97
4.25	3.20	0.056	74
4.50	3.38	0.043	57
4.75	3.57	0.0327	43
5.00	3.76	0.0260	34
5.25	3.95	0.0195	26

Precipitation data : Probable Maximum Precipitation for 200 square miles - 24 hours (in inches) = 23.8"

Maximum 6 hour percentage = 113%

Maximum 12 hour percentage = 123%

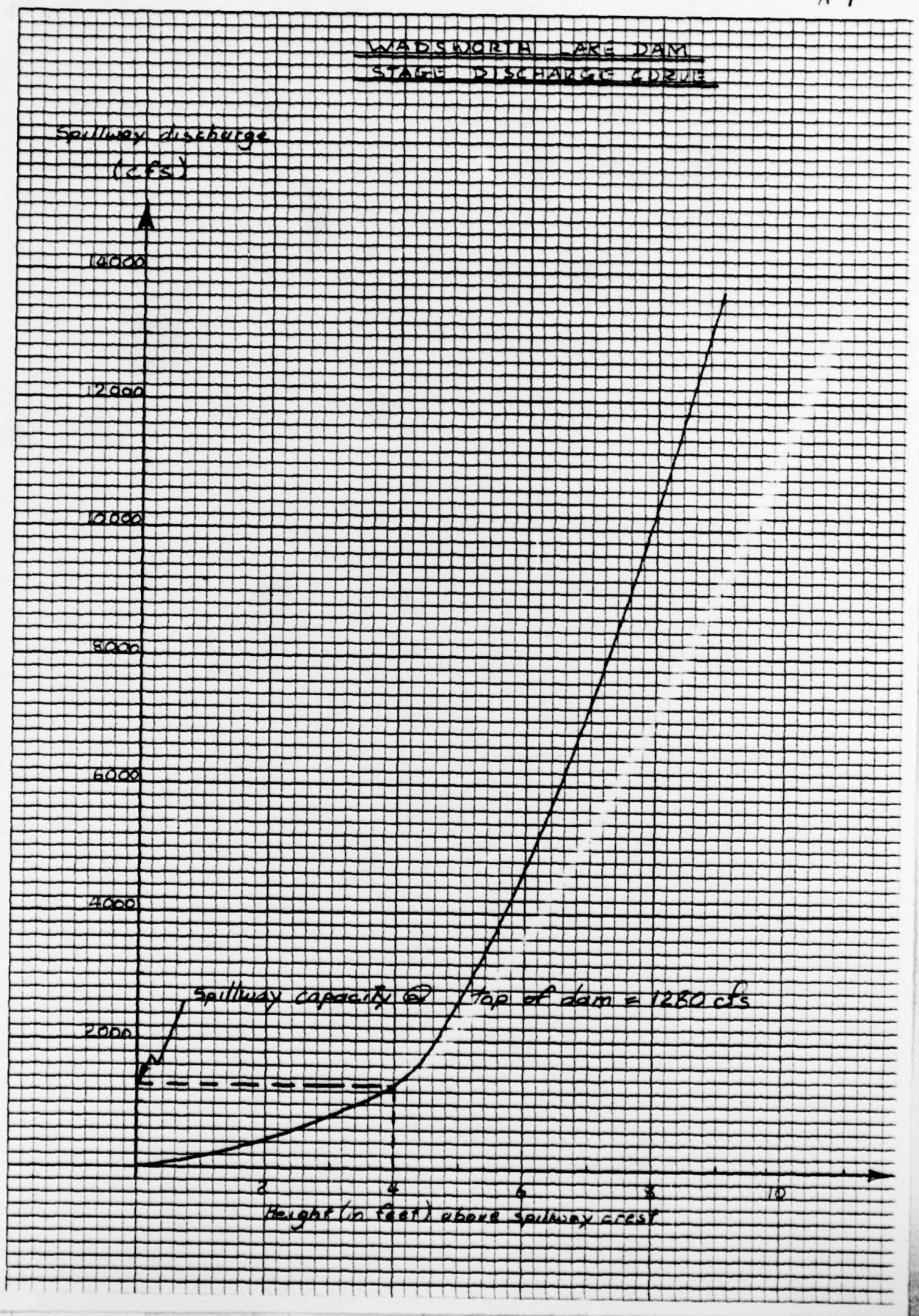
Maximum 24 hour percentage = 132%

BY D.J.M. DATE 6-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A3 OF
CHKD. BY DATE WARSWORTH LAKE DAM PROJECT 6234
SUBJECT

Spillway discharge

Over spillway crest Effective length = 50'			Over dam L=(350-50)			ΣQ
H	C	Q	H	C	Q	(cfs)
1	3.2	160				160
2	3.2	453				453
3	3.2	831				831
4	3.2	1280	0			1,280
5	3.2	1789	1	2.8	840	2,629
6	3.2	2352	2	2.8	2376	4,728
7	3.2	2963	3	2.8	4365	7,328
8	3.2	3620	4	2.8	6720	10,340
9	3.2	4320	5	2.8	9391	13,711
10	3.2	5060	6	2.8	12345	17,405
11	3.2	5837	7	2.8	15557	21,394

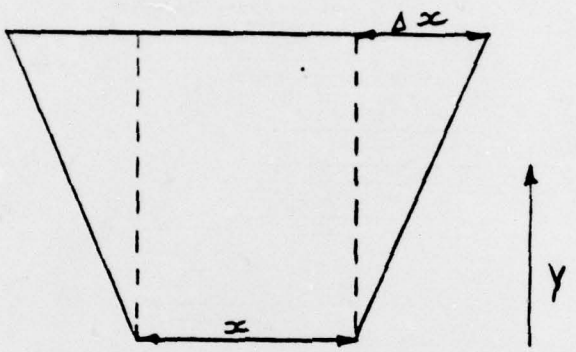
AVERAGE DAM CREST IS ASSUMED TO BE 75 ±



Surcharge storage :

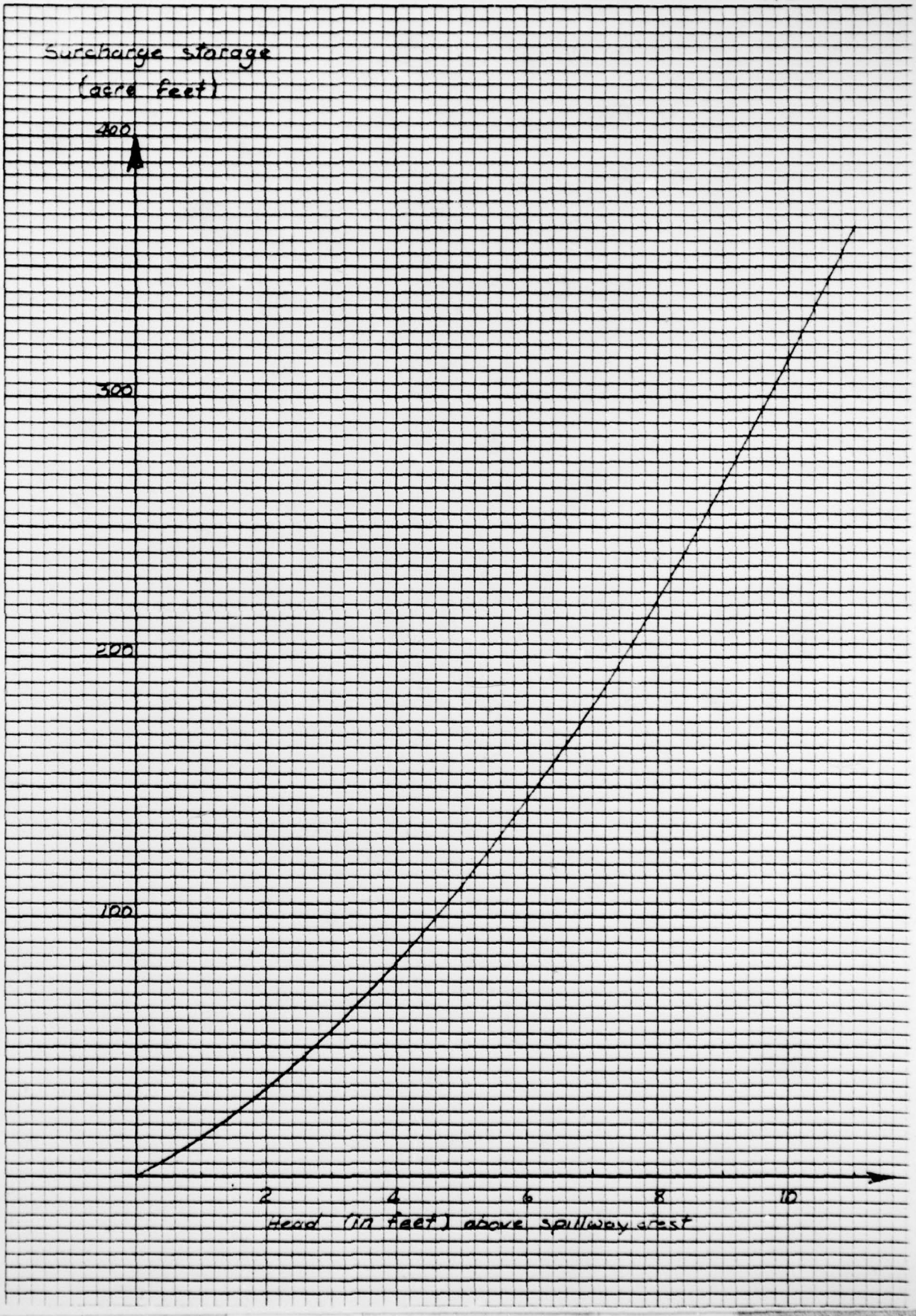
area of lake @ El. 71 = 13.3 acres

area of next contour (El. 80) = 45.8 acres



Increment in volume $\Delta V = (x + \Delta x)Y$

Height above spillway crest	Surcharge storage (acre feet)
0	
1	15
2	34
3	56
4	82
5	112
6	145
7	182
8	222
9	266
10	314
11	365



BY D.J.M. DATE 7-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A7 OF
CHKD. BY DATE WADSWORTH LAKE DAM PROJECT C234
SUBJECT Approximate drawdown calculations

Assume available head with 2.5' tailwater = 2'

Storage @ normal pool = 70 acre-feet

Assume drawdown in two equal stages with no inflow

Stage 1)

$H = 6'$

$Q = 0.55 \times \pi \times \sqrt{64.32 \times 6} = 34$ cfs

$\therefore$ time $= \dfrac{70 \times 43560}{34 \times 2 \times 3600}$

$= 12.5$ hours

Stage 2)

$H = 2'$

$Q = 0.55 \times \pi \times \sqrt{64.32 \times 2} = 20$ cfs

$\therefore$ time $= \dfrac{70 \times 43560}{20 \times 2 \times 3600}$

$= 21.18$ hours

Σ time $= (12.5 + 21.18)/24$

$= 1.4$ days

Say 1½ days

STERLING LAKE DAM INSPECTION & WADSWORTH LAKE DAM INSPECTION
BY D.J.MULLIGAN
JUNE 14 1979

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
100	0	15	0	0	0	0	0	0	0

JOPER	NWT
3	0

****

SUB-AREA RUNOFF COMPUTATION

INFLOW TO STERLING LAKE

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
1	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	-1	3.10	0.0	3.10	0.80	0.500	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	23.80	113.00	123.00	132.00	0.0	0.0	0.0

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.0	0.0	1.00	0.0	0.0	1.00	0.50	0.10	0.0	0.0

GIVEN UNIT GRAPH, NUHGG= 20

89.	313.	685.	1039.	1179.	1089.	907.	697.	514.	390.
295.	226.	163.	123.	94.	71.	53.	40.	32.	24.

UNIT GRAPH TOTALS 8023. CFS OR 1.00 INCHES OVER THE AREA

RECESSION DATA

STRTQ= 0.0 QRCSN= 0.0 RTIOR= 1.00

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.03	0.00	0.
2	0.03	0.00	0.
3	0.03	0.00	0.
4	0.03	0.00	0.
5	0.03	0.00	0.
6	0.03	0.00	0.
7	0.03	0.00	0.
8	0.03	0.00	0.
9	0.03	0.00	0.
10	0.03	0.00	0.
11	0.03	0.00	0.
12	0.03	0.00	0.
13	0.03	0.00	0.

14	0.03	0.00	0.
15	0.03	0.00	0.
16	0.03	0.00	0.
17	0.03	0.00	0.
18	0.03	0.00	0.
19	0.03	0.00	1.
20	0.03	0.00	3.
21	0.03	0.00	6.
22	0.03	0.00	10.
23	0.03	0.00	14.
24	0.03	0.00	17.
25	0.08	0.05	25.
26	0.08	0.05	43.
27	0.08	0.05	79.
28	0.08	0.05	133.
29	0.08	0.05	194.
30	0.08	0.05	250.
31	0.08	0.05	296.
32	0.08	0.05	332.
33	0.08	0.05	359.
34	0.08	0.05	379.
35	0.08	0.05	394.
36	0.08	0.05	405.
37	0.08	0.05	414.
38	0.08	0.05	420.
39	0.08	0.05	425.
40	0.08	0.05	428.
41	0.08	0.05	431.
42	0.08	0.05	433.
43	0.08	0.05	435.
44	0.08	0.05	436.
45	0.08	0.05	436.
46	0.08	0.05	436.
47	0.08	0.05	436.
48	0.08	0.05	436.
49	0.54	0.51	477.
50	0.54	0.51	620.
51	0.54	0.51	934.
52	0.54	0.51	1411.
53	0.65	0.62	1961.
54	0.65	0.62	2494.
55	0.65	0.62	2984.
56	0.65	0.62	3415.
57	0.81	0.78	3792.
58	0.81	0.78	4138.
59	0.81	0.78	4482.
60	0.81	0.78	4828.
61	2.04	2.02	5258.
62	2.04	2.02	5920.
63	2.04	2.02	6588.
64	2.04	2.02	8443.
65	0.75	0.73	9511.
66	0.75	0.73	10949.
67	0.75	0.73	11259.
68	0.75	0.73	10835.
69	0.59	0.57	9967.
70	0.59	0.57	9017.
71	0.59	0.57	8119.
72	0.59	0.57	7346.
73	0.04	0.02	6653.
74	0.04	0.02	5961.

75	0.04	0.02	5179.
76	0.04	0.02	4297.
77	0.04	0.02	3422.
78	0.04	0.02	2652.
79	0.04	0.02	2025.
80	0.04	0.02	1544.
81	0.04	0.02	1167.
82	0.04	0.02	881.
83	0.04	0.02	663.
84	0.04	0.02	496.
85	0.04	0.02	398.
86	0.04	0.02	324.
87	0.04	0.02	268.
88	0.04	0.02	225.
89	0.04	0.02	196.
90	0.04	0.02	174.
91	0.04	0.02	156.
92	0.04	0.02	143.
93	0.04	0.02	143.
94	0.04	0.02	143.
95	0.04	0.02	143.
96	0.04	0.02	143.
97	0.0	0.0	142.
98	0.0	0.0	136.
99	0.0	0.0	124.
100	0.0	0.0	105.
SUM	25.12	22.60	181557.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	11259.	6492.	1891.	1816.	181554.
INCHES		19.48	22.70	22.70	22.70
AC-FT		3221.	3753.	3753.	3753.

RUNOFF MULTIPLIED BY 0.50

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
3.	5.	7.	9.	12.	21.	40.	67.	97.	125.
148.	166.	179.	189.	197.	203.	207.	210.	212.	214.
216.	217.	217.	218.	218.	218.	218.	218.	238.	310.
467.	705.	980.	1247.	1492.	1707.	1896.	2069.	2241.	2414.
2629.	2960.	3494.	4222.	4956.	5475.	5630.	5418.	4983.	4509.
4060.	3673.	3327.	2980.	2590.	2148.	1711.	1326.	1012.	772.
583.	441.	331.	248.	199.	162.	134.	112.	98.	87.
78.	72.	72.	72.	72.	72.	71.	68.	62.	53.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5630.	3246.	946.	908.	90777.
INCHES		9.74	11.35	11.35	11.35
AC-FT		1610.	1877.	1877.	1877.

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HYDROGRAPH ROUTING

ROUTING THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
11	1	0	0	0	0	1

ROUTING DATA

LOUIS BERGER & ASSOCIATES INC.

BY D.J.M DATE ________ SHEET NO. A11 OF ____

CHKD. BY ______ DATE ________ STERLING LAKE DAM PROJECT C-234

SUBJECT ____________________

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

STORAGE=	0.	10.	38.	57.	78.	102.	128.	157.	189.	224.
OUTFLOW=	0.	66.	343.	933.	1884.	3074.	4462.	6021.	7734.	9452.

TIME	EOP STOR	AVG IN	EOP OUT
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	0.	0.	0.
5	0.	0.	0.
6	0.	0.	0.
7	0.	0.	0.
8	0.	0.	0.
9	0.	0.	0.
10	0.	0.	0.
11	0.	0.	0.
12	0.	0.	0.
13	0.	0.	0.
14	0.	0.	0.
15	0.	0.	0.
16	0.	0.	0.
17	0.	0.	0.
18	0.	0.	0.
19	0.	0.	0.
20	0.	1.	0.
21	0.	2.	0.
22	0.	4.	1.
23	0.	6.	1.
24	0.	8.	2.
25	1.	10.	3.
26	1.	17.	5.
27	1.	30.	8.
28	2.	53.	14.
29	3.	82.	23.
30	5.	111.	34.
31	7.	137.	47.
32	9.	157.	61.
33	11.	173.	80.
34	13.	184.	99.
35	15.	193.	116.
36	17.	200.	132.
37	18.	205.	145.
38	19.	208.	157.
39	20.	211.	167.
40	21.	213.	176.
41	22.	215.	183.
42	22.	216.	189.
43	23.	217.	194.
44	23.	218.	199.
45	24.	218.	202.
46	24.	218.	205.
47	24.	218.	207.
48	24.	218.	209.
49	25.	228.	213.
50	26.	274.	224.

LOUIS BERGER & ASSOCIATES INC.

STERLING LAKE DAM

52	35.	586.	316.
53	44.	843.	529.
54	53.	1114.	813.
55	61.	1369.	1130.
56	68.	1600.	1429.
57	73.	1802.	1667.
58	78.	1983.	1868.
59	82.	2155.	2061.
60	85.	2327.	2242.
61	89.	2522.	2431.
62	94.	2795.	2677.
63	102.	3227.	3050.
64	112.	3858.	3623.
65	125.	4589.	4309.
66	137.	5215.	4956.
67	145.	5552.	5382.
68	147.	5524.	5483.
69	143.	5201.	5281.
70	136.	4746.	4899.
71	128.	4284.	4460.
72	120.	3866.	4038.
73	113.	3500.	3655.
74	106.	3154.	3299.
75	99.	2785.	2940.
76	91.	2369.	2553.
77	83.	1930.	2131.
78	75.	1518.	1726.
79	67.	1169.	1371.
80	60.	892.	1066.
81	54.	678.	846.
82	49.	512.	684.
83	44.	386.	539.
84	40.	290.	418.
85	37.	224.	336.
86	34.	181.	307.
87	31.	148.	277.
88	28.	123.	249.
89	26.	105.	222.
90	23.	92.	198.
91	21.	83.	177.
92	19.	75.	158.
93	18.	72.	142.
94	16.	72.	129.
95	15.	72.	118.
96	14.	72.	110.
97	14.	71.	102.
98	13.	69.	96.
99	12.	65.	90.
100	12.	57.	84.
SUM			90219.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5483.	3230.	940.	902.	90219.
INCHES		9.69	11.28	11.28	11.28
AC-FT		1603.	1865.	1865.	1865.

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BY D.J.M. DATE .....
CHKD. BY ..... DATE .....
SUBJECT .....

LOUIS BERGER & ASSOCIATES INC.

WADSWORTH LAKE DAM

SHEET NO. A13 OF .....
PROJECT C-234

INFLOW TO LAKE WADSWORTH DAM INCLUDES OUTFLOW FROM UPSTREAM DAM (STERLING LAKE DAM - NJ00434)

SUB-AREA RUNOFF COMPUTATION

INFLOW TO WADSWORTH LAKE (NOT FROM STERLING)

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
2	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	-1	3.60	0.0	3.60	0.80	0.500	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	23.80	113.00	123.00	132.00	0.0	0.0	0.0

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.0	0.0	1.00	0.0	0.0	1.00	0.50	0.10	0.0	0.0

GIVEN UNIT GRAPH, NUHGQ= 21

88.	329.	697.	1091.	1302.	1268.	1078.	868.	642.	497.
380.	291.	221.	163.	125.	57.	74.	57.	43.	34.
26.									

UNIT GRAPH TOTALS 9371. CFS OR 1.01 INCHES OVER THE AREA

RECESSION DATA

STRTQ= 0.0 QRCSN= 0.0 RTIOR= 1.00

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.03	0.00	0.
2	0.03	0.00	0.
3	0.03	0.00	0.
4	0.03	0.00	0.
5	0.03	0.00	0.
6	0.03	0.00	0.
7	0.03	0.00	0.
8	0.03	0.00	0.
9	0.03	0.00	0.
10	0.03	0.00	0.
11	0.03	0.00	0.
12	0.03	0.00	0.
13	0.03	0.00	0.
14	0.03	0.00	0.
15	0.03	0.00	0.
16	0.03	0.00	0.
17	0.03	0.00	0.
18	0.03	0.00	0.
19	0.03	0.00	1.
20	0.03	0.00	3.
21	0.03	0.00	6.
22	0.03	0.00	10.
23	0.03	0.00	15.
24	0.03	0.00	19.
25	0.08	0.05	27.
26	0.08	0.05	46.
27	0.08	0.05	84.
28	0.08	0.05	141.
29	0.08	0.05	208.
30	0.08	0.05	273.
31	0.08	0.05	329.
32	0.08	0.05	375.

LOUIS BERGER & ASSOCIATES INC.

WADSWORTH LAKE DAM

33	0.08	0.05	406.
34	0.08	0.05	432.
35	0.08	0.05	451.
36	0.08	0.05	466.
37	0.08	0.05	478.
38	0.08	0.05	486.
39	0.08	0.05	492.
40	0.08	0.05	497.
41	0.08	0.05	501.
42	0.08	0.05	504.
43	0.08	0.05	506.
44	0.08	0.05	508.
45	0.08	0.05	509.
46	0.08	0.05	509.
47	0.08	0.05	509.
48	0.08	0.05	509.
49	0.54	0.51	550.
50	0.54	0.51	700.
51	0.54	0.51	1020.
52	0.54	0.51	1520.
53	0.65	0.62	2127.
54	0.65	0.62	2744.
55	0.65	0.62	3313.
56	0.65	0.62	3828.
57	0.81	0.78	4277.
58	0.81	0.78	4694.
59	0.81	0.78	5097.
60	0.81	0.78	5500.
61	2.04	2.02	5589.
62	2.04	2.02	6729.
63	2.04	2.02	7863.
64	2.04	2.02	9429.
65	0.75	0.73	11087.
66	0.75	0.73	12355.
67	0.75	0.73	12884.
68	0.75	0.73	12622.
69	0.59	0.57	11777.
70	0.59	0.57	10734.
71	0.59	0.57	9725.
72	0.59	0.57	8808.
73	0.04	0.02	8009.
74	0.04	0.02	7193.
75	0.04	0.02	6307.
76	0.04	0.02	5318.
77	0.04	0.02	4311.
78	0.04	0.02	3395.
79	0.04	0.02	2634.
80	0.04	0.02	2027.
81	0.04	0.02	1576.
82	0.04	0.02	1203.
83	0.04	0.02	919.
84	0.04	0.02	700.
85	0.04	0.02	533.
86	0.04	0.02	434.
87	0.04	0.02	359.
88	0.04	0.02	300.
89	0.04	0.02	255.
90	0.04	0.02	224.
91	0.04	0.02	200.
92	0.04	0.02	181.
93	0.04	0.02	167.

94	0.04	0.02	167.
95	0.04	0.02	167.
96	0.04	0.02	167.
97	0.0	0.0	166.
98	0.0	0.0	160.
99	0.0	0.0	147.
100	0.0	0.0	128.
SUM	25.12	22.60	212017.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	12884.	7552.	2208.	2120.	212013.
INCHES		19.51	22.83	22.83	22.83
AC-FT		3747.	4383.	4383.	4383.

RUNOFF MULTIPLIED BY 0.50

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
3.	5.	7.	9.	13.	23.	42.	70.	104.	137.
164.	187.	203.	216.	226.	233.	239.	243.	246.	249.
251.	252.	253.	254.	255.	255.	255.	255.	275.	350.
510.	760.	1063.	1372.	1656.	1914.	2138.	2347.	2548.	2750.
2995.	3365.	3932.	4714.	5544.	6178.	6442.	6311.	5886.	5367.
4862.	4404.	4004.	3696.	3154.	2559.	2155.	1697.	1317.	1014.
788.	601.	459.	350.	266.	217.	179.	150.	127.	112.
100.	91.	84.	84.	84.	84.	83.	80.	74.	64.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6442.	3776.	1104.	1060.	106006.
INCHES		9.76	11.41	11.41	11.41
AC-FT		1873.	2191.	2191.	2191.

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COMBINE HYDROGRAPHS

COMBINED INFLOW TO WADSWORTH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
22	2	0	0	0	0	1

SUM OF 2 HYDROGRAPHS AT 22

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
3.	6.	9.	12.	17.	28.	50.	84.	127.	171.
211.	248.	283.	315.	342.	365.	384.	400.	413.	424.
433.	441.	447.	452.	457.	460.	462.	464.	488.	574.
765.	1076.	1502.	2185.	2787.	3344.	3805.	4215.	4610.	4992.
5426.	6042.	6981.	8337.	9853.	11133.	11823.	11794.	11170.	10266.
9322.	8442.	7660.	6895.	6094.	5212.	4286.	3423.	2688.	2279.
1633.	1285.	998.	768.	602.	524.	457.	399.	350.	310.
277.	249.	225.	212.	202.	193.	185.	176.	164.	148.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	11823.	6996.	2044.	1962.	196226.
INCHES		9.71	11.35	11.35	11.35
AC-FT		3471.	4056.	4056.	4056.

BY DJM DATE
CHKD. BY DATE
SUBJECT

LOUIS BERGER & ASSOCIATES INC.
WADSWORTH LAKE DAM
SHEET NO. A-16 OF
PROJECT

HYDROGRAPH ROUTING

ROUTING THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
222	1	0	0	0	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

STORAGE=	0.	15.	56.	82.	112.	145.	222.	266.	314.	365.
OUTFLOW=	0.	160.	831.	1280.	2629.	4728.	10340.	13711.	17405.	21394.

TIME	EOP STOR	AVG IN	EOP OUT
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	0.	0.	0.
5	0.	0.	0.
6	0.	0.	0.
7	0.	0.	0.
8	0.	0.	0.
9	0.	0.	0.
10	0.	0.	0.
11	0.	0.	0.
12	0.	0.	0.
13	0.	0.	0.
14	0.	0.	0.
15	0.	0.	0.
16	0.	0.	0.
17	0.	0.	0.
18	0.	0.	0.
19	0.	0.	0.
20	0.	1.	0.
21	0.	2.	1.
22	0.	5.	1.
23	0.	7.	3.
24	0.	10.	4.
25	1.	14.	6.
26	1.	22.	9.
27	1.	39.	15.
28	2.	67.	26.
29	4.	105.	41.
30	6.	149.	63.
31	8.	191.	88.
32	11.	229.	116.
33	14.	265.	146.
34	16.	299.	184.
35	19.	328.	225.
36	21.	354.	262.
37	23.	375.	295.
38	25.	392.	323.
39	26.	407.	347.
40	28.	419.	368.
41	29.	429.	386.
42	30.	437.	400.

43	30.	444.	413.
44	31.	450.	424.
45	32.	455.	433.
46	32.	458.	440.
47	32.	461.	446.
48	33.	463.	451.
49	33.	476.	458.
50	35.	531.	479.
51	38.	670.	534.
52	45.	921.	646.
53	57.	1334.	846.
54	75.	1888.	1161.
55	95.	2486.	1872.
56	112.	3065.	2629.
57	124.	3574.	3379.
58	132.	4010.	3879.
59	138.	4413.	4302.
60	145.	4801.	4698.
61	151.	5209.	5134.
62	158.	5734.	5649.
63	168.	6512.	6390.
64	183.	7659.	7481.
65	202.	9095.	8868.
66	221.	10493.	10264.
67	235.	11478.	11335.
68	240.	11809.	11754.
69	237.	11482.	11514.
70	228.	10718.	10811.
71	216.	9794.	9924.
72	204.	8882.	9029.
73	192.	8051.	8189.
74	182.	7277.	7406.
75	171.	6494.	6623.
76	160.	5653.	5790.
77	147.	4749.	4896.
78	134.	3855.	4057.
79	122.	3055.	3263.
80	111.	2383.	2578.
81	101.	1856.	2120.
82	91.	1459.	1701.
83	83.	1142.	1346.
84	76.	883.	1171.
85	67.	685.	1024.
86	59.	563.	884.
87	52.	490.	768.
88	46.	428.	670.
89	41.	374.	584.
90	36.	330.	511.
91	33.	293.	448.
92	29.	263.	394.
93	27.	237.	349.
94	24.	219.	311.
95	22.	207.	281.
96	21.	197.	257.
97	20.	189.	237.
98	19.	181.	221.
99	18.	170.	206.
100	17.	156.	192.
SUM			195428.

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	1	5630.	3246.	946.	908.	3.10
ROUTED TO	11	5483.	3230.	940.	902.	3.10
HYDROGRAPH AT	2	6442.	3776.	1104.	1060.	3.60
2 COMBINED	22	11823.	6996.	2044.	1962.	6.70
ROUTED TO	222	11754.	6969.	2036.	1954.	6.70

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	11754.	6969.	2036.	1954.	195428.
INCHES		9.68	11.31	11.31	11.31
AC-FT		3458.	4040.	4040.	4040.